DISASTER

Data Interoperability Solution At Stakeholders Emergency Reaction

285069

D2.40 Technical implications compilation report

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Executive summary

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Ontology requirements have been obtained from the interaction between domain experts in the crisis-management field, and ontology experts and business analysts. The coverage requirements of the ontology are formulated as competency questions that are understood by all stakeholders (both technical and non-technical people). This approach fosters communication between these groups. Alongside with the requirements that define the scope of the ontology, some technical requirements describe the life-cycle of the knowledge.

The mediation requirements are organized according to the data mediation workflow, and fix the boundaries of the scope for the mediation components.

Finally, regarding the integrated system, a bottom-up scenario-driven approach has been followed to extract the requirements. Two scenarios have been selected for development in the context of this project, involving a cross-border moor fire and an air cargo accident at an international airport. Since no deliverable is yet being released including scenarios, the annex of this document briefly introduces current descriptions for an appropriate understanding of this deliverable.

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Abbreviations

ACME: Fictional name of a company used in the examples of this document

AEMET: Agencia Estatal de Meteorología (Spanish Meteorology Agency)

CSV: Comma Separated Values

EM-DAT: Emergency Events Database

EMS: Emergency Management System

Eurostat: Statistical office of the European Union

EuroVoc: Multilingual Thesaurus of the European Union

GDI4DM: Geospatial Data Infrastructure for disaster management

GHS: Globally Harmonized System of Classification and Labelling of Chemicals

GML: Geography Markup Language

HTML: HyperText Markup Language

HTTP: HyperText Transfer Protocol

HXL: Humanitarian Exchange Language

IATA: International Air Transport Association

JDBC: Java Database Connectivity

JSON: JavaScript Object Notation

KML: Keyhole Markup Language

MUO: Measurement Units Ontology

NatCatSer: Natural Catastrophe loss database Service

NEN: Nationale Normalisatie-Instituut (Dutch Standardization Institute)

NUTS: Nomenclature of territorial units for statistics

N3: Notation 3

NeOn: Networked Ontologies (project acronym)

OntoClean: A methodology for ontology-driven conceptual analysis

OSM: Open Street Maps

OWL: Web Ontology Language

QGIS: Quantum GIS

QML: Quantum GIS style file

RDF: Resource Description Framework

RDF DATAC: RDF Data Cube

REST: REpresentational State Transfer

RSS: Really Simple Syndication

SEM: Simple Event Model

SKOS: Simple Knowledge Organization System

SPARQL: Simple Protocol and RDF Query Language

SOAP: Simple Object Access Protocol

TOWL: Time-determined Ontology Web Language

URL: Uniform Resource Locator

WAI: Who Am I!

WGS: World Geodetic System

WMS: Web Map Service

W3C: World Wide Web Consortium

XML: eXtensible Markup Language

Definitions

Competency question: A technique for establishing the ontology requirements. They are defined as natural language questions that the ontology to be built should be able to answer.

Emergency Management System: A system that enables communication and collaboration amongst first-responders and gives support to decision makers providing all the available information about an incident. An EMS frequently supports emergency stakeholders at operational, strategic and tactical level.

Scenario Card: It is a template that defines the relevant situational and operational data to describe an incident according to emergency stakeholders specific information needs (e.g., time, role and scale). Apart from the incident scenario description, it contains the global crisis management plan and a response protocol (i.e., standardised checklist of actions).

1 Introduction

This report contains the technical requirements that will drive the developments of the DISASTER ontology (Work Package 3), the mediation components (WP4) and the integrated system (WP5). The structure of the document matches this arrangement.

This deliverable is related to D2.10, D2.20 and D2.31/D2.32, which collect non-technical requirements. Due to its concurrent development, there might be mismatches and misunderstandings of non-technical requirements that will be fixed in subsequent stages of the project.

The aim of the ontology in DISASTER project is to provide a common data model shared by all stakeholders in order to solve operational data exchange problems in crisis management situations. Ontology requirements have been obtained from the interaction between domain experts in the crisis-management field, and ontology experts and business analysts. The coverage requirements of the ontology are formulated as competency questions that are understood by all stakeholders (both technical and non-technical people). This approach fosters communication between these groups. Alongside with the requirements that define the scope of the ontology, some technical requirements describe the life-cycle of the knowledge.

Format and schema heterogeneity are frequent hindrances for interoperability between information systems. This is the case of emergency management systems. In combination with shared, flexible ontology, DISASTER proposes alignment and mediation techniques to overcome such communication failures. The mediation requirements are organized according to the data mediation workflow, and fix the boundaries of the scope for the mediation components.

Finally, regarding the integrated system to be developed in this project, a bottom-up scenario-driven approach has been followed to extract the requirements. Two scenarios have been selected for development in the context of this project, involving a cross-border moor fire and an air cargo accident at an international airport. Since no deliverable is yet being released including scenarios, the annex of this document briefly introduces current descriptions for an appropriate understanding of this deliverable.

2 Ontology requirements

This chapter describes the requirements for the DISASTER ontology to be developed in WP3.

The requirements are split in two blocks. The first one deals with the management of the ontology lifecycle. Several stages are considered here: ontology authoring, ontology publication and sharing, ontology maintenance, ontology documentation, and existing knowledge re-use. Requirements in this group are identified by the pattern **O.x.x**, see Section 2.1. Each requirement is described with a short title and an optional comment. Requirements are linked to the DISASTER Work Package that is concerned.

The second block captures the coverage requirements of the ontology, i.e., the requirements describe which pieces of information must be represented by the ontology. Each requirement takes the form of a "competency question", according to the OntoClean and NeON methodologies for ontology design [1] [3].

Competency questions are informal questions written in natural language that should be answered by the ontology once the ontology is expressed in a formal language, in our case OWL2. These questions and their answers are both used to drive the extraction of the main concepts, properties and formal axioms of the ontology. For instance, from a question like "How much arsine gas from ACME tanks has leaked?", the ontology designer detects that a classification of gases is needed in the ontology. Therefore, competency questions and their responses play the role of a type of **requirement specification** against which the ontology can be evaluated [2].

Requirements in this group are identified by the pattern **Rx**, see Section 2.2. Each competency question has a companion sample answer, and deals with a particular kind of knowledge. The DISASTER ontology will be modular, and each requirement is classified according to its module. The 'Available resources' column points to existing data sources from where the information can be acquired. Finally, the last column indicates existing data schemas, preferably expressed in ontology languages, that describe the information.

Requirements in both groups are assigned a relative importance in a scale that ranges from 5 (highest priority, critical requirement) to 1 (lowest priority, nice to have).

2.1 Ontology lifecycle requirements

These requirements have been derived from the experience of the project team, especially TREELOGIC and CTIC, on ontology-based applications. These are common needs in most semantic applications in order to manage the knowledge captured in an ontology, from its inception to its later maintenance. The aim of these requirements is to cover the complete ontology life-cycle. These requirements are covered in Table 1.

In the context of this section, the users are those people who are responsible for developing and maintaining the ontology. The profile is that of a ontology engineer being supported by domain experts. On an initial phase, the partners in WP3 will start the design and development of the ontology. But it is envisioned that external collaborators outside DISASTER consortium can contribute in the maintenance and update of the ontology in further phases.

Table 1 Ontology lifecycle requirements

Id.	Requirement	To:	Importance	Comments
O.1	**Ontology authoring**	**WP3**	**-**	**-**
O.1.1	Users will be able to use ontology authoring tools that support OWL2	WP3	5	The market already provides a good offer of authoring tools
O.1.2	Collaborative authoring should be possible	WP3	2	The market already provides some tooling to support collaborative authoring
O.2	**Ontology publication/sharing**	**WP3**	**-**	**-**
O.2.1	Infrastructure must be in place to make ontologies available on the web	WP3	5	Best practices defined by W3C must be observed.
O.3	**Ontology maintenance**	**WP3**	**-**	**-**
O.3.1	Changes in the ontologies must be automatically tracked (ontology versioning)	WP3	2	-
O.3.2	Authorship information must be attached to ontology elements		4	-
O.4	**Ontology documentation**	**WP3**	**-**	**-**
O.4.1	Reference documentation must be automatically made available for ontologies	WP3	5	-

O.4.2	Meta-information in the ontologies must be used to generate their documentation	WP3	5	-
O.5	**Knowledge resources re-use**	**WP3/4**	**-**	**-**
O.5.1	Include existing ontological resources in the ontology	WP3	5	-
O.5.2	Re-use non-ontological resources	WP4	3	E.g., thesauri can be transformed into SKOS and then referenced from the ontology

2.2 Coverage and domain scope requirements

The following competency questions have been obtained from the collaboration between crisis-management domain experts and ontology modellers and business analysts within the project consortium. Furthermore, conversations were held with experts from outside the consortium, in particular with Dutch experts, through electronic means (LinkedIn), who have helped to clarify the information needs.

Moreover, a dedicated workshop was held in Cologne (Germany), organized by the project and hosted by Cologne University of Applied Sciences, in early May 2012. About 40 experts attended the meeting and discussed the current challenges on effective communication and data exchange at crisis management.

The following Table 2 reflects these inputs. All these requirements are to be taken into account in WP3.

Table 2 Coverage and domain scope requirements

Req.	Competency question & sample answer	Type of knowledge	Module	Importance	Available resource	Data schema
R1	In which geographical point is the incident located? *The WGS84 coordinates are 51.89N, 6.10W*	Spatial	Transversal	5	-	NeoGeo, wgs84, GeoSPARQL
R2	In which administrative region is the disaster located? *In the Colunga county, province of Asturias, Spain*	Spatial	Transversal	4	NUTS, Geonames	NeoGeo, GeoSPARQL
R3	What kind of incident, disaster or hazard? *A train wreckage*	Disaster	Core/Vertical	5	EM-DAT, NatCatSer.	GDI4DM, HXL, National Incident Classification (e.g.: meldings classificatie)
R4	What is the intensity of the fire? *Large size*	Disaster	Vertical	2	-	-
R5	What is the weather forecast? *Strong winds from NE until 18:00, light showers (less than 3mm) tomorrow*	Environmental	Transversal	4	AEMET & others	-
R6	How many people are affected? *3 dead, 12 injured, 2,000 evacuated, 50,000 under alert*	Casualties, stats	Transversal/ vertical	5	-	RDF DataC, Triage Classification
R7	What is the population affected by the disaster? *60% workers of ACME factory, 20% children nearby school, rest are residents*	People description	Transversal	3	-	FOAF, WAI, RDF DataC.
R8	Which normative regulates chemical disasters in Spain? *It is the Real Decreto 13/2007.*	Document	Vertical	3	National and EU regulations	EuroVoc
R9	What is the disaster response protocol in a freight train wreck? *1) Rescue people trapped in wagons, 2) patient triage, etc.*	Workflow	Vertical	3	Regional, National and EU regulations	-
R10	What kind of toxic substances are involved in the ACME factory disaster? *Chlorine, liquid sodium hydroxide, and liquid cresol derailed.*	Chemical	Vertical	5	GHS	-
R11	How many children have been affected by earthquakes in Asia in the last decade? *Around 500,000 children*	Stats	Core	2	Eurostat, UN	RDF DataC.
R12	How much arsine gas from ACME tanks has leaked? *More than 10,000 tons*	Chemical & metrics	Vertical	5	-	MUO
R13	Which is the distance between ACME factory and the nearby school? *1.7 km*	Spatial & metrics	Transversal	5	-	NeoGeo, GeoSPARQL, MUO
R14	Which are possible routes from the headquarters to the disaster area? *Take A-66, then take exit to airport.*	Spatial	Transversal	1	-	NeoGeo, GeoSPARQL
R15	Who are the first responders involved in a freight train crash carrying highly toxic gas? *Fire brigades, national police and ambulances*	stakeholders resources	Core/Vertical	5	-	-
R16	How the toxic cloud is going to move in the next hours according to the model? *Moving towards East at 15 km/h, reaching Metropolis in 2 hours*	Spatial, temporal	Transversal	3	-	-

R17	Which has been the sequence of events since the accident in the factory? *First call at 8:02am, arrival of internal response team at 8:09am, building evacuation completed at 8:16am*	Temporal	Transversal	4	-	SEM
R18	Which was the sequence of events that led to the accident? *Lightning was observed in the area from 07:40am to 08:12am. Tanks were fully pressurized since 05:00am.*	Temporal	Transversal	4	-	SEM
R19	How many toxic cloud incidents have occurred in Europe due to train wreckages in the last 30 years? *35 incidents with victims*	Stats	Transversal	4	Eurostat, UN	RDF DataC.
R20	When did the disaster happen? *The train wreck was Sunday 18th May 2011, at 06:02pm local time.*	Temporal	Transversal	5	-	SEM, tOWL
R21	Where is Fire Brigade 23 located right now? *It's located at WGS84 coordinates 51.89N, 6.10W*	Temporal, spatial & stakeholder resources	Transversal/ vertical	5	-	NeoGeo, WGS84, GeoSPARQL
R22	Which emergency units have responded to the disaster? *Fire brigade 23, trunk 25, police car 821, ambulance 1209.*	Stakeholder resources	Vertical	5	-	-
R23	Which emergency units are available near the emergency area? *Fire brigade 92 and University Hospital are located within a 5 Km radius*	Spatial, stakeholder resources	Transversal/ vertical	5	-	-
R24	Where can shelters be found near the disaster area? *A school building and a sport centre are located 1 Km NW of the accident area*	Spatial	Transversal	4	OSM	NeoGeo, WGS84, GeoSPARQL
R25	What is the capacity of the water deposits of this fire truck model? *It can load 30 Ton of water*	Stakeholder resources	Vertical	42	-	MUO
R26	What flammable or explosive materials are located near the accident? *A petrol station is located 300 m South*	Spatial, chemical	Transversal/ vertical	54	-	NeoGeo, WGS84, GeoSPARQL
R27	What's the meaning of a white "RTW" icon in a German map? *An ambulance*	Symbol sets	Vertical	5	National regulations	-
R28	What's the meaning of "Vollbrand" in German? *A large fire*	Language	Vertical	5	National regulations	-
R29	What information does a policeman at Bronze Level need to know? *Assessment of the immediate risks in his nearby context*	Spatial, symbol sets, language	Vertical	4	Scenario cards	-
R30	How to represent a fire truck in a Dutch map? *A red box with a truck silhouette*	Symbol sets	Vertical	5	National regulation	NEN 1414
R31	Where have the injured been transported? *All injured are being treated at University Hospital*	Casualties	Vertical	2	-	-
R32	Who owns this area of forest between Portugal and Spain? *This territory belongs to Spain, Salamanca autonomous region, Ciudad Rodrigo county*	Spatial	Transversal	3	OSM, Geonames, NUTS	-
R33	Who is competent to fight a fire inside the factory premises? *The local (city) fire brigade overrides the authority of the company's security team*	Gov. structure	Vertical	3	National and EU regulations	-
R34	Which is the assessment of the current situation? *A critical emergency, fire is out of control, there is risk to human lives*	Disaster	Core	5	-	-
R35	Which protocols must be activated if the situation becomes worse? *Request help from the Army to evacuate a 20 Km perimeter*	Workflow	Vertical	3	National and EU regulations	-
R36	Which is the affected area? *The neighbourhood surrounding ACME factory*	Spatial	Transversal	5	-	NeoGeo, GeoSPARQL

3 Mediation component requirements

This chapter enumerates the technical requirements regarding data mediation, and is an input for Work Package 4, and particularly for the design of the data mediation components.

The scope of these components covers from the initial data acquisition to the final exploitation of mediated data, including the pure mediation tasks of definition and execution of alignments. These four tasks describe the mediation workflow of Figure 2.

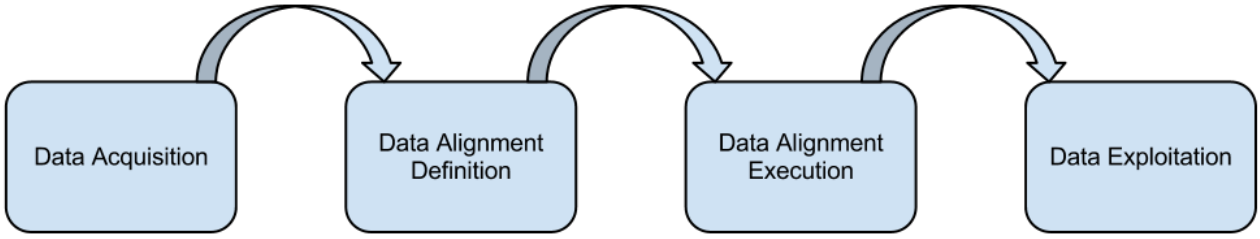

Figure 1 Mediation Workflow

As an example, we can think of an information sharing scenario where two firemen brigades, one at each side (A and B) of the border area in fire, need to exchange information for a better understanding of the current situation. Side A offers a map with the position of the team and their latest description of the fire. This information needs to be accessed by side B (data acquisition), previous or live mappings between A and B data models need to be defined (data alignment definition) in order to convert data from model A to model B (data alignment execution). Finally, side B might need some data filtering and/or conversion to specific visualisation formats (data exploitation).

For a better understanding of each step we recommend reading D4.10 [4], which contains a comprehensive work on the state of the art in mediation and alignment techniques.

Data mediation requirements have been grouped in four tables according to the mediation workflow depicted in Figure 2. Each table covers the implications of one step in the workflow.

The structure of the tables is consistent, and contains the same five columns. *Id* and *technical requirements* columns identify every requirement with a code (**A.x.x, B.x.x, C.x.x, Dx.x**) and a succinct, representative name respectively. Column *to* specifies which work package will be responsible of fulfilling the requirement. Field *importance* highlights the priority the requirement is given for planning purposes. Priorities range between 5 (highest priority, critical requirement) and 1 (lowest priority, nice to have). Finally, the last field contains *comments* about the requirement, including additional remarks.

The entries of these tables are organized hierarchically. The numbering of the identifiers indicates the structure of the hierarchy. Top-level groups, which have a high level of abstraction, are highlighted in bold. The specific requirements are at the bottom level of the hierarchy.

3.1 Data acquisition requirements

Data acquisition requirements are those related with getting access to the data from its sources, and keeping the data up-to-date. Table 3 details the data acquisition requirements.

Table 3 Data acquisition requirements

ID	Technical Requirements	To	Importance	Comments
A.1	**Data acquisition**	**WP4**	**-**	**-**
A.1.1	Supported data acquisition protocols	WP4	-	This group of requirements describe the protocols that are used to get access to the data
A.1.1.1	Obtain data from HTTP URL	WP4	5	-
A.1.1.2	Obtain data from file	WP4	5	-
A.1.1.3	Obtain data from SPARQL Endpoint	WP4	4	-
A.1.1.4	Obtain data from relational database	WP4	5	Relational databases can be accessed through standardized protocols, such as JDBC
A.1.1.5	Obtain data from RESTful web service	WP4	4	-
A.1.1.6	Obtain data from SOAP web service	WP4	2	-
A.1.2	Supported data acquisition formats	WP4	-	This group of requirements describe the data formats the data may be available in
A.1.2.1	Read general-purpose XML	WP4	3	-
A.1.2.2	Read RDF/XML and N3	WP4	5	-
A.1.2.3	Read relational database tables	WP4	5	-
A.1.2.4	Read JSON	WP4	4	-
A.1.2.5	Read spreadsheets	WP4	4	-
A.1.3	Supported data acquisition formats (geospatial-specific)	WP4	-	This group specializes A.1.2 for geospatial data
A.1.3.1	Read shapefile	WP4	4	Proprietary format
A.1.3.2	Read KML	WP4	5	-
A.1.3.3	Read GML	WP4	4	-
A.1.3.4	Read PostGIS	WP4	3	-
A.1.3.5	Read QML (QGIS style file)	WP4	2	-
A.1.3.6	Read QGIS	WP4	2	-
				-
A.2	**Data source description and sync policies**	**WP4**	**-**	**Define and execute policies to maintain synchronization with the data source**
A.2.1	Periodically poll data source for updates at programmable intervals	WP4	2	-
A.2.2	Subscribe to data source updates push notifications	WP4	2	-
				-
A.3	**Data acquisition filtering**	**WP4**	**-**	**The ability to control the data that is acquired**
A.3.1	Query-based data filtering	WP4	2	-

3.2 Data alignment definition requirements

This group of requirements deals with establishing correspondences between ontologies and linking resources from different data sets. Both automatic and manual alignments are taken into account. Finally, policies are needed to drive the data integration process. Table 4 contains the complete list of requirements of this kind.

Table 4 Data alignment definition requirements

ID	Technical Requirements	To	Importance	Comments
B.1	**Data scheme alignment automatic discovery**	**WP4**	**-**	**The mappings between elements of two data schemes may be automatically discovered**
B.1.1	Detect equivalent domain concepts (class or instance)	WP4	4	**-**
B.1.2	Detect broader/narrower matches at concept level	WP4	2	-
B.1.3	Detect equivalent properties	WP4	4	Attribute values may need to be transformed among schemes (e.g., unit conversion, language, etc.)
B.1.4	Detect broader/narrower matches at property level	WP4	2	-
B.1.5	Get information about the confidence of the matching	WP4	4	-
B.2	**Data scheme alignment manual specification**	**WP4**	**-**	**The mappings between elements of two data schemes may be specified by the user**
B.2.1	Indicate the equivalence of two domain concepts (class or instance)	WP4	5	-
B.2.2	Indicate the broader/narrower relation between two domain concepts	WP4	5	-
B.2.3	Indicate equivalent properties	WP4	5	-
B.2.4	Indicate broader/narrower matches at property level	WP4	5	-
B.2.5	Indicate the confidence of the alignment	WP4	5	-
B.2.6	Specify the function that transforms values between data schemes	WP4	5	E.g., unit conversion, field split, etc.
B.3	**Data integration policies specification**	**WP4**	**-**	**The user indicates the policy to follow when merging runs into difficulties**
B.3.1	Indicate the policies regarding data redundancy	WP4	3	E.g., smushing duplicate, report duplicates to original sources
B.3.2	Indicate the policies regarding data inconsistencies	WP4	4	E.g., prune to a consistent subset, enrichment to a consistent subset, report to original sources, give priority to one of the sources (based on trustworthy, last-update, etc.)
B.3.3	Indicate the policies regarding data incompleteness	WP4	3	E.g., remove incomplete data, fill using additional, ask user, report to original sources

3.3 Data alignment execution requirements

This third group of requirements exploit the alignments to perform the actual data mediation and transformation. Data integration policies take effect as part of this process. Table 5 provides the list of data alignment execution requirements.

Table 5 Data alignment execution requirements

ID	Technical Requirements	To	Importance	Comments
C.1	**Data alignment execution**	**WP4**	**-**	**The system applies the alignments to transform a dataset to a different data schema. This execution may be requested by a user or by another software component**
C.1.1	Execute alignments between data schemes to transform an original dataset from one data schema to another	WP4	5	E.g., the transformation of a geographical dataset described according to a given map symbol classification
C.2	**Data integration execution**	**WP4**	**-**	**The data integration policies are executed to coherently merge datasets. This execution may be requested by a user or by another software component**
C.2.1	Execute data redundancy policies	WP4	3	-
C.2.2	Execute data inconsistency policies	WP4	4	-
C.2.3	Execute data incompleteness policies	WP4	3	-

3.4 Data exploitation requirements

This last group of requirements involve functionalities provided by the mediation component in order to take advantage of the mediated and consolidated data. These requirements are independent of the potential usage scenarios. Table 6 covers the list of data exploitation requirements.

Table 6 Data exploitation requirements

ID	Technical Requirements	To	Importance	Comments
D.1	**Data filtering**	**WP4**	**-**	**Select relevant subsets of the available information tailored for specific needs**
D.1.1	Data views	WP4	-	Population of data patterns meeting specific criteria
D.1.1.1	Answer SPARQL CONSTRUCT queries	WP4	5	-
D.1.2	Query answering	WP4	-	Provide fact-based answers to queries in formal query language
D.1.2.1	Answer SPARQL SELECT/ASK queries	WP4	5	-
D.2	**Data export**	**WP4**	**-**	**-**
D.2.1	Supported data export protocols	WP4	-	-
D.2.1.1	Save data to a file	WP4	5	-
D.2.1.2	Push data to a SPARQL endpoint	WP4	2	-
D.2.1.3	Submit data to a RESTful web service	WP4	3	-
D.2.2	Supported data export formats	WP4	-	-
D.2.2.1	Save RDF/XML and N3	WP4	5	-
D.2.2.2	Save RDF/JSON	WP4	5	-
D.2.2.3	Save CSV	WP4	3	For table-like views
D.2.2.4	Save relational database tables	WP4	4	For table-like views
D.2.2.5	Save HTML	WP4	1	-
D.2.3	Supported data export formats (geospatial-specific)	WP4	-	-
D.2.3.1	Save KML	WP4	5	-
D.3	**Web publication**	**WP4**	**-**	**Data, or specific subsets, can be made available using web protocols (“linked data”)**
D.3.1	Expose data on the web as “linked data”	WP4	5	-
D.3.2	Publish RSS feeds	WP4	1	-
D.3.3	Expose a SPARQL endpoint interface	WP4	5	-
D.3.4	Publish data dumps for bulk download	WP4	3	-
D.4	**Explain the origin of the data (provenance)**	**WP4**	**-**	**Users may request information about the source of the data to assess their trustworthiness**
D.4.1	Get information about the origin of pieces of data and the transformations that have been applied	WP4	5	Explanation of results

4 Integrated system requirements

The requirements in this chapter deal with the integrated system that will be built by Work Package 5. This is an input for deliverables D5.21 and D5.22.

These requirements have been extracted from the analysis of scenarios to be considered in the project, following a bottom-up approach. A questionnaire was prepared and sent to the domain experts in the consortium in order to gather their requirements with respect to some realistic situations. More precisely, some scenarios have been selected and elaborated: border moor fire and airport cargo. These scenarios are further described in Annex (see Chapter 6).

Table 7 Integrated system requirements

Id.	Technical Requirements	From non-technical requirements	Scenario Issue	To:	Comments
E.1	Agreed procedures of interoperability	Giving access to secured data	Border moor fire: Organization	WP5	How and what data is allowed to be shared. Creating agreements / advice on how to create such agreements
E.2	Situational and operational terms translation/ interpretation	Translation of EMS operation terminology for the supervisory authority report	Border moor fire: Supervisory Government Report	WP5	Translation based on text (name/description) for terms, abbreviations, materials, locations, units, indications, infrastructures, vehicles, buildings, and icons.
		Some terms and abbreviations may require on the fly translation	Airport Cargo		
E.3	Situational and operational symbols translation/ interpretation	Translation of EMS operation for the supervisory government report	Border moor fire: Supervisory Government Report	WP5	Translation based on text (name/description/icons) for symbols connecting to national symbol set repositories like NEN 1414 in the Netherlands.
		Some indications of hazardous/toxic/explosive materials may require on the fly translation	Airport Cargo		
E.4	Scenario Card definition	Reduce information to the most important one	Border moor fire: Supervisory Government Report	WP5	Defining situational and operational data needed for each specific situation.
E.5	Situational and operational information filtering by scenario card	Using filtering of incident classification structure	Airport Cargo	WP5	Filtering information by means of scenario card in order to adapt it to a specific situation.
E.6	Sharing situational and operational terms.	The format of the air cargo system has to be made available in the EMS	Airport Cargo	WP5	Using several formats and channels.
E.7	Sharing situational and operational symbols.	The format of the air cargo system has to be made available in the EMS	Airport Cargo	WP5	Using several formats and channels.
E.8	Sharing spatial information data.	The map system of the airport has to produce some WMS services into the EMS geographic viewer.	Airport Cargo	WP5	Using several formats and channels.

5 Conclusions

This report contains the compilation of requirements for the technical Work Packages of the DISASTER project, i.e., WP3, WP4 and WP5. As such, this document is an input to drive the technical work and to measure the success of the project results.

Nevertheless, these requirements have been defined in parallel to the non-technical requirements addressed by Deliverable D2.10, D2.20, D2.31 and D2.32. As such, some inconsistencies may arise, and the requirements may be subject to future changes. The picture may become clearer when more feedback is received from the final versions of those documents, and from the initial works of technical packages.

6 Annex

6.1 Scenario Definition (Current Status)

According to the research methodology defined and adopted in DISASTER, tasks related to the definition of scenarios are on-going since the beginning of the project, and being a guide to research activities. This has also been considered for the requirement compilation.

Since no deliverable related to scenarios is being released at this stage, relevant information is being included as an annex to this document for a full understanding on some of the requirements mentioned in Sections2 and 4, i.e., ontology requirements and integrated system requirements, respectively.

At this stage, two different, complementary scenarios have been identified as relevant to provide several interoperability challenges to be addressed and solved by DISASTER proposed solution:

- Border moor fire: a fire in a border area, where different response teams will be cooperating with each other from each side of the border. This scenario involves issues such as translation, information sharing procedures in an international context, different standards for information representation, different cultural background, concepts and methodologies, amongst others.

- Air cargo: an airplane crash accident involving unknown cargo. In this case, private-public information exchange is included, in addition to some of the previously mentioned issues that are shared by both scenarios.

For the technical perspective required for this document, a template was defined for a common identification and analysis of a number of issues related to interoperability. Some of them will be addressed by means of mediation techniques. A number of categories were previously identified, so that scenarios would provide details for specific situations where interoperability issues are present in current situation.

Thus, each scenario identifies a number of specific situations where interoperability issues are present in information exchange processes. Such situations are classified according to two different categories:

- Situation category, depending on the relationship among those who are aiming to share certain data:

    - 0.1: Intra-EMS-Organization Interoperability.
    - 0.2: Inter-EMS-Organization Interoperability
    - 1: National Inter-Organization Interoperability (involving non-EMS)
    - 2: International-EMS-Organization Interoperability
    - 3: International Inter-Organization Interoperability (involving Non-EMS).

- Mediation category, depending on which specific mediation issue is mentioned, and how it is being addressed by DISASTER solution:

    - Technical Interoperability issues: protocol/format mediation.
    - Linguistic interoperability: language mediation / translation needed.
    - Background/cultural issues: concept mediation.
    - Data representation issues: symbols/icons/colours... mediation.
    - Information overload: data filtering needed.

In the following sections, specific interoperability situations identified in each scenario are listed according to the common template.

6.1.1 Border moor fire Scenario: Specific issues description

6.1.1.1 Supervisory Government Report

Table 8 Border Moor fire Scenario: Supervisory Government Report

Situation category	1: National Inter-Organization Interoperability (involving non-EMS)
Mediation category	D) Data representation issues (symbols/icons/colors... mediation)
Description: what the problem to be solved is	**Current situation:** [Description of the current situation where the interoperability issue is identified from a user perspective]
	The German government has a supervisory role. That is why German incident command is requested to send periodical reports to the supervisory county government. The reports are written in plain text. The supervisory county government is not able to understand the situation properly due to a lack of visual information.
	Expected situation: [What the situation would be like after DISASTER-based solution has been deployed (proof of concept to be developed)]
	Information is shared across all participation organizations in the most effective way including images and maps wherever possible in order to include much context information.
From (Actor) [Who is the owner of the information]	German side emergency manager
To (Actor) [Who is expecting to get data]	German supervisory county government agent
From (System name) [The system the information in sent from]	Gronau district EMS
To (System name) [The system where information is expected to be received]	Münster County Government
Involved data / information to be shared [What kind of information is involved in the communication]	Situational information in plain text / Situational information including graphics
Technical details	
B) Linguistic interoperability (language mediation / translation needed)	Translation of Dutch EMS operation for the supervisory government report.
C) Background/cultural issues (concept mediation)	Translation of Dutch EMS operation for the supervisory government report.
D) Data representation issues (symbols/icons/colors... mediation)	Possibility to include graphics in a report (which is NOT just to share the situation map)
E) Information overload (data filtering needed)	Not possible since report will reduce information to the most important once.

6.1.1.2 Aerial Pictures

Table 9 Border Moor fire Scenario: Aerial Pictures

Situation category	0.1: Intra-EMS-Organization Interoperability
	0.2: Inter-EMS-Organization Interoperability
	1: National Inter-Organization Interoperability (involving non-EMS)
	2: International-EMS-Organization Interoperability
	3: International Inter-Organization Interoperability (involving Non-EMS)
Mediation category	A) Technical Interoperability issues (protocol/format)
Description: [what the problem to be solved is]	**Current situation:** [Description of the current situation where the interoperability issue is identified from a user perspective]
	Aerial pictures of the scene are taken on a regular basis. However the decision maker is not able to locate the picture on a map since spatial data is missing.
	Expected situation: [What the situation would be like after DISASTER-based solution has been deployed (proof of concept to be developed)]
	Since situational information is tightly linked to spatial information, geographical data should be transmitted with the information wherever possible. Nevertheless the format of geodata needs to be translated.
From (Actor) [Who is the owner of the information]	Dutch helicopter crew
To (Actor) [Who is expecting to get data]	Dutch & German incident commander
From (System name) [The system the information in sent from]	Helicopter
To (System name) [The system where information is expected	EMS incident command

to be received]	
Involved data / information to be shared [What kind of information is involved in the communication]	Picture / Picture &Geodata
Technical details	
A) Technical interoperability issues (protocol/format mediation)	Maybe the camera is able to create geodata which is not transmitted. Then adding geodata to every chunk of information is a necessary requirement.
C) Background/cultural issues (concept mediation)	Helicopter crew needs to understand that geoinformation is crucial. This is something for the DISASTER handbook.
D) Data representation issues (symbols/icons/colors... mediation)	Picture cannot be represented on a map.

6.1.1.3 Translation

Table 10 Border Moor fire Scenario: Translation

Situation category	2: International-EMS-Organization Interoperability
	3: International Inter-Organization Interoperability (involving Non-EMS)
Mediation category	B) Linguistic interoperability (language mediation / translation needed)
	C) Background/cultural issues (concept mediation).
Description: [what the problem to be solved is]	**Current situation:** [Description of the current situation where the interoperability issue is identified from a user perspective]
	Dutch and German EMS have agreed on a handbook that offers translations and explanations for the most relevant units and operational items.
	Expected situation: [What the situation would be like after DISASTER-based solution has been deployed (proof of concept to be developed)]
	Translation will be done automatically by DISASTER including explanations of the most relevant items.
From (Actor) [Who is the owner of the information]	Dutch / German EMS crews
To (Actor) [Who is expecting to get data]	Dutch / German EMS crews
From (System name) [The system the information in sent from]	Dutch / German EMS
To (System name) [The system where information is expected to be received]	Dutch / German EMS
Involved data / information to be shared [What kind of information is involved in the communication]	Names and description of relevant operational items
Technical details	
B) Linguistic interoperability (language mediation / translation needed)	Names of units and involved personnel
C) Background/cultural issues (concept mediation)	Organizational understanding of the others EMS concept (can be achieved by description)
D) Data representation issues (symbols/icons/colors... mediation)	Icons must be translated in the same way as the representing name of the object in order to avoid irritation

6.1.1.4 Organization

Table 11 Border Moor fire Scenario: Organization

Situation category	0.2: Inter-EMS-Organization Interoperability
	1: National Inter-Organization Interoperability (involving non-EMS)
	2: International-EMS-Organization Interoperability
	3: International Inter-Organization Interoperability (involving Non-EMS)
Mediation category	B) Linguistic interoperability (language mediation / translation needed)
	C) Background/cultural issues (concept mediation).
Description: [what the problem to be solved is]	**Current situation:** [Description of the current situation where the interoperability issue is identified from a

	user perspective]
	Agreements are formulated between the Dutch and German EMS / Government in order to be able to use the others information
	Expected situation: [What the situation would be like after DISASTER-based solution has been deployed (proof of concept to be developed)]
	DISASTER Handbook will include advice on how to create a situation by agreements that enables the actors to use the interoperability system.
From (Actor) [Who is the owner of the information]	Dutch / German EMS / Government
To (Actor) [Who is expecting to get data]	Dutch / German EMS / Government
From (System name) [The system the information in sent from]	Dutch / German EMS
To (System name) [The system where information is expected to be received]	Dutch / German EMS
Involved data / information to be shared [What kind of information is involved in the communication]	Agreed procedures of interoperability (how and what data is allowed to be shared)
Technical details	
A) Technical interoperability issues (protocol/format mediation)	Giving access to secured data.
C) Background/cultural issues (concept mediation)	Creating the mentioned agreements / advice on how to create such agreements.

6.1.2 Air Cargo Scenario: Specific issues description

6.1.2.1 Translating, filtering and sharing.

Table 12 Air Cargo Scenario: Translating, filtering and sharing

Situation category	3: International Inter-Organization Interoperability (involving Non-EMS)
Mediation category	A) Technical interoperability issues (protocol/format mediation).
	B) Linguistic interoperability (language mediation / translation needed)
	D) Data representation issues (symbols/icons/colours... mediation).
	E) Information overload (data filtering needed).]
Description: what the problem to be solved is	**Current situation:** [Description of the current situation where the interoperability issue is identified from a user perspective]
	A number of agents in the information chain provide vital data to identify the seriousness of the incident with considerable effects for the operations of the entire airport. The goal is to reduce the time-to-decision maker who can re-diagnose based on actual data feeds.
	Expected situation: [What the situation would be like after DISASTER-based solution has been deployed (proof of concept to be developed)]
	The expected situation is a better integration between the private operational systems, custom cargo systems and the national EMS to enable direct feed of relevant contextual data and factual data like location, freight/cargo risks and surrounding buildings in order to make fast and relevant risk assessments, appropriate emergency action and reduce impact.
From (Actor) [Who is the owner of the information]	Customs cargo
To (Actor) [Who is expecting to get data]	Chief emergency officer driving to airport in order to start bronze team who requires as much data as possible on his vehicle information system which is part of the EMS representation
From (System name) [The system the information in sent from]	Cargo information system and airport geographical system (context, location, buildings, units, symbols and icons
To (System name) [The system where information is expected to be received]	EMS and vehicle information system EMS
Involved data / information to be shared [What kind of information is involved in the communication]	Freight/cargo data overall and specific, buildings, type of buildings, location, infrastructure, units at site, Released by electronic scenario card in case of emergency.
Technical details	
A) Technical interoperability issues (protocol/format mediation).	The format of the air cargo system has to be made available in the EMS The map system of the airport has to produce some WMS services into the EMS geographic viewer.

B) Linguistic interoperability (language mediation / translation needed)	Some terms and abbreviations are IATA international terminology and may require translation. Some indications of hazardous/toxic/explosive materials may require on the fly translation
D) Data representation issues (symbols/icons/colors... mediation)	Location of airplane, exchange of maps, exchange of indications for freight, location, exits, buildings, vehicles, conform NEN 1414 set of symbols. Some have to be translated on the fly using RDF infrastructure.
E) Information overload (data filtering needed)	Using filtering of incident classification structure (VOS 3 = airplane incident category three)

6.1.3 Scenario Interoperability Issues Summary

Table 13 Scenario Interoperability Issues Summary

Id.	Non-technical requirement	Scenario
A	Intra EMS Organization Interoperability	
A.1	**Technical Interoperability issues (protocol/format)**	
A.1.1	Share location and situational information by radio from Control Room	Border moor fire: Supervisory Government Report
A.1.2	Add geodata to every chunk of information	Border moor fire: Aerial Pic
A.2	**Linguistic interoperability (language mediation / translation needed)**	
A.3	**Background/cultural issues (concept mediation).**	
A.4	**Data representation issues (symbols/icons/colors... mediation).**	
A.4.1	Picture must to be represented on a map.	Border moor fire: Aerial Pic
A.5	**Information overload (data filtering needed).**	
B	Inter EMS Organization Interoperability	
B.1	**Technical Interoperability issues (protocol/format)**	
B.2	**Linguistic interoperability (language mediation / translation needed)**	
B.3	**Background/cultural issues (concept mediation).**	
B.4	**Data representation issues (symbols/icons/colors... mediation).**	
B.5	**Information overload (data filtering needed).**	
C	National Inter-Organization Interoperability	
C.1	**Technical Interoperability issues (protocol/format)**	
C.2	**Linguistic interoperability (language mediation / translation needed)**	
C.2.1	Translation of EMS operation for the supervisory government report	Border moor fire: Supervisory Government Report
C.3	**Background/cultural issues (concept mediation).**	
C.3.1	Translation of EMS operation for the supervisory government report	Border moor fire: Supervisory Government Report
C.4	**Data representation issues (symbols/icons/colors... mediation).**	
C.4.1	Possibility to include graphics and situational information in a report	Border moor fire: Supervisory Government Report
C.5	**Information overload (data filtering needed).**	
C.5.1	Reduce information to the most important once	Border moor fire: Supervisory Government Report
D	International-EMS-Organization Interoperability	
D.1	**Technical Interoperability issues (protocol/format)**	
D.2	**Linguistic interoperability (language mediation / translation needed)**	
D.2.1	Translation will be done automatically by DISASTER including explanations of the most relevant items.(Names of units, involved personnel)	Border moor fire: Translation
D.3	**Background/cultural issues (concept mediation).**	
D.3.1	Organizational understanding of the others EMS concept (can be achieved by description)	Border moor fire: Translation
D.4	**Data representation issues (symbols/icons/colors... mediation).**	
D.4.1	icons must be translated in the same way as the representing name of the object in order to avoid irritation	Border moor fire: Translation
D.5	**Information overload (data filtering needed).**	
E	International Inter-Organization Interoperability (involving Non-EMS)	
E.1	**Technical Interoperability issues (protocol/format)**	
E.1.1	Giving access to secured data	Border moor fire: Organization
E.1.2	The format of the air cargo system has to be made available in the EMS	Airport Cargo
E.1.3	The map system of the airport has to produce some WMS services into the EMS geographic viewer.	Airport Cargo
E.1.4	The systems where information is expected to be received are EMS and vehicle information system	Airport Cargo
E.2	**Linguistic interoperability (language mediation / translation needed)**	
E.2.1	Some terms and abbreviations are IATA international terminology or Customs and transportation terminology and may require translation	Airport Cargo

E.2.2	Some terms and abbreviations are IATA international terminology and may require translation or international customs and transportation terminology	Airport Cargo
E.2.3	Some indications of hazardous/toxic/explosive materials may require on the fly translation, probably those related to international norm set for toxic and dangerous cargo and issues like pressured air	Airport Cargo
E.3	**Background/cultural issues (concept mediation).**	
E.3.1	Creating agreements	Border moor fire: Organization
E.4	**Data representation issues (symbols/icons/colors... mediation).**	
E.4.1	Have to be translated on the fly using RDF infrastructure	Airport Cargo
E.5	**Information overload (data filtering needed).**	
E.5.1	Using filtering of incident classification structure (VOS 3 = airplane incident category three)	Airport Cargo
E.5.2	The systems where information is expected to be received are EMS and vehicle information system	Airport Cargo

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